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ASSESSMENT OF POTENTIAL FOR COMMONALITY OF ADP FOR ARMY AND MARINE CORPS C2 IN SELECTED FUNCTIONAL AREAS

Volume I: Executive Summary and Briefing

R. P. Walker, *Project Leader*

December 1989

Prepared for
Deputy Under Secretary of Defense for Acquisition (Tactical Warfare Programs/Land Warfare)
and
Assistant Secretary of Defense (C3I)

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This briefing reports (1) a review of requirements for ADP support of tactical command and control for the Army and Marine Corps, (2) an analysis of existing or emerging system options of one Service that could potentially be used by the other Service at a system or subsystem level, and (3) identification of options and issues with emphasis on interoperability issues. The assessment is limited to three function areas (maneuver control, fire support, and air operations/airspace control). The system-of-system concepts for Army and Marine Corps tactical systems (ATCCS, MTACCS) are discussed. The assessment concludes that there is substantial commonality of requirements and potential for multi-Service programs leading to fielding common system support of maneuver control, fire support, and battlefield air picture. Further, unless otherwise directed, the two Services may implement incompatible standards for data communications and data management.

14. SUBJECT TERMS
Fire Support, System Concepts, Maneuver Control, Air Operations, Airspace Control, Battlefield Air Picture, Requirements, ATCCS, MTCCS, FIREFLEX, FIREMAN, Interoperability, A2C2, AFATDS, MCS, FAAD C2I, TAIS, DASC, IDASC, Assessment, Concept Evaluation, Acquisition, COM, BOM, Bit-Oriented, MTS

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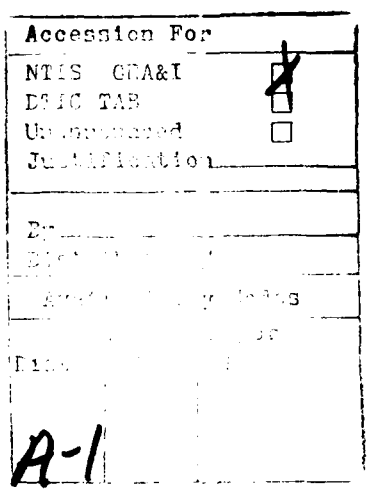

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PREFACE

This study has been conducted in response to a request from the Deputy Undersecretary of Defense for Acquisition (Tactical Warfare Programs/Land Warfare) and the Assistant Secretary of Defense (C3I).[1] The objective of this task was to review ADP support requirements for tactical command and control for the Army and Marine Corps in the areas of maneuver control, fire support, and air operations and to evaluate the potential of existing and emerging systems of one Service to meet, or be adapted to meet, the requirements of the other Service.

This task was accomplished by the System Evaluation Division of the Institute for Defense Analyses (IDA). The study team consisted of Dr. Robert P. Walker (Project Leader), LGen Ernest C. Cheatham (USMC, Ret.), MGen Gregory A. Corliss (USMC, Ret.), and Dr. Lane B. Scheiber. The study team would like to thank the many people who contributed to and reviewed the results of the study. At the risk of being incomplete, the study team would especially like to thank Mr. William J. Barlow, MGen Edward Bautz (USA, Ret.), Col John M. Bryden (USA, Ret.), MGen John L. Gerrity (USA, Ret.), Dr. C. Leslie Golliday, Dr. Richard E. Ivanetich, Dr. Peter S. Liou, Mr. Theodore F. Maggelet, Dr. James P. Pennell, Dr. David L. Randall, Dr. Eugene Simaitis, and Mrs. Paula B. Yagodich for their critical reviews, helpful suggestions, and timely assistance.

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1 *Assessment of Subsystem Commonality for Selected Army and Marine Corps C2 Systems*, Contracts MDA 903 84-C-0031 and MDA 903 89-C-0003, Task Order T-F1-654, 1 November 1988, and Amendment No. 1 thereto, UNCLASSIFIED.

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(Published Under Separate Cover)

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INTRODUCTION

BACKGROUND

After the termination in 1987 of a program called the Marine Integrated Fire and Air Support System (MIFASS), which addressed command and control (C2) requirements for fire support, the Marine Corps reviewed its automated data processing (ADP) support requirements and issued in 1989 a required operational capability (ROC) statement for a Flexible Fire Support System (FIREFLEX). The Army and Marine Corps signed a Memorandum of Agreement to cooperatively develop the Army's Advanced Field Artillery Tactical Data System (AFATDS) to serve as the objective fire support system for both Services. A multi-Service program for FIREFLEX and AFATDS began in 1989.

The Marine Corps has also been reviewing its requirements for its system-of-systems concept, the Marine Tactical Command and Control System (MTACCS), and for ADP support of its four functional areas--Ground C2, Aviation C2, Combat Service Support (CSS) C2, and Intelligence. Support for Ground C2 will include a maneuver control system called the Fire and Maneuver System (FIREMAN). In addition, a force-level control system, together with a high-level database, for support of the Marine Air-Ground Task Force (MAGTF) Commander is planned; this system is called the Tactical Combat Operations System (TCO).

The Army Tactical Command and Control System (ATCCS) is a system of systems with five functional areas: maneuver control, fire support, air defense, intelligence and electronic warfare, and CSS. Five major development programs are underway to develop ADP-supported control systems in each of these areas; these are, respectively, the Maneuver Control System (MCS); AFATDS; Forward Area Air Defense (FAAD) Command, Control, and Information System (C2I); All-Source Analysis System (ASAS); and Combat Service Support Control System (CSSCS). In the Army, force-level control capability is planned for initial fielding with MCS in 1993.

A major concern within OSD was whether the commonality of requirements for ADP support of C2 in the Army and Marine Corps could lead to substantial commonality of the development programs in the two Services, specifically in the areas of maneuver control, fire support, and air operations. Consequently, IDA was tasked[1] to review areas of commonality of requirements and to evaluate the degree to which the existing and emerging systems of one Service can meet, or can be adapted to meet, the requirements of the other Service.

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1 A copy of the background, objective, and statement of work for this Task Order is provided in Volume II, Appendix F.

Since IDA had reviewed the fire support requirements and assessed system options in a previous study effort,[2] the current task was to focus on maneuver control and selected aspects of air operations (specifically, airspace control).[3] Finally, IDA was asked to identify tactical C2 issues, specifically those concerned with interoperability.

OUTLINE OF THE REPORT

Volume I begins with a short Executive Summary describing the analysis performed and summarizing the results. Following the Executive Summary is an Executive Briefing (Part I), which presents the information that was briefed to OSD on 20 December 1989, consisting primarily of the results of the study. Volume II contains a Technical Briefing (Part II), which provides the detailed information and assessments that led to the results summarized in the Executive Briefing. Information contained in the Technical Briefing was reviewed by the Army and Marine Corps in December 1989--additional information provided by the Services has been incorporated, and the data are considered accurate as of 15 December 1989.

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2 IDA Paper P-2165, *Assessment of ADP for USMC Fire Support*, November 1988, UNCLASSIFIED.

3 IDA has conducted three related studies for OSD. In 1985, IDA reviewed ATCCS concepts in IDA Memorandum Report M-107, *An Independent Review of the Army Tactical Command and Control System*, August 1985, UNCLASSIFIED. In 1986, IDA conducted a fire support C2 assessment in IDA Paper P-1991, *An Independent Review of Two Fire Support Systems, AFATDS and MIFASS*, January 1987, UNCLASSIFIED. More recently, IDA assessed Army and Air Force tactical data systems in IDA Report R-326, *Assessment of Tactical Data Systems*, April 1989, SECRET.

EXECUTIVE SUMMARY

This study addresses the question of whether there is sufficient commonality of requirements between the Army and the Marine Corps so that multi-Service programs could be developed in maneuver control, fire support, and air operations for airspace coordination and control.

BACKGROUND

The Army has already begun fielding an operational system for maneuver control (MCS) to the heavy divisions, whereas the Marine Corps has unsatisfied ROCs for maneuver (FIREMAN) and force-level (TCO) control. Currently, the Marine Corps is relying on the capabilities provided by Fleet Marine Force (FMF)-developed software and off-the-shelf hardware (FMF Initiatives). The key issue for the assessment of maneuver control is whether the requirements that would drive the selection of an objective system for the Marine Corps could be satisfied by MCS or the FMF Initiatives (or both).

The Services have already begun a multi-Service program to develop a single system to meet the fire support C2 requirements of both the Army (AFATDS) and the Marine Corps (FIREFLEX). The key issue for the fire support assessment is whether fielding a system for both Services could be achieved without a major schedule risk to the existing AFATDS program.

For airspace operations, the study focused on the need and opportunities to provide a battlefield air picture, integrating land warfare situation data with selected air track, aircraft position, and airspace coordination information. The issue for the battlefield air picture is whether such a display is required and can be made available without major investment for use in support of functions other than air defense.

CONCLUSIONS

The assessments conducted in this study show that the Army and the Marine Corps have very similar requirements in all three areas: maneuver control, fire support, and use of a battlefield air picture in air operations for airspace coordination and control. In each of these areas there is potential for the Services to cooperatively develop and field common ADP support.

Specifically, the Army and the Marine Corps could field a common objective system for maneuver control and a common system for fire support. A multi-Service program has already begun for fire support, and the Services are now discussing the possibility of a multi-Service program in maneuver control. Further, the Services have a common need and can be expected to develop similar types of support for a battlefield air picture. A multi-Service program for support of the battlefield air picture could be developed (in support of functions other than air defense).

Unless otherwise directed, the Army and the Marine Corps may implement incompatible standards in their tactical data systems for data communications and data management. Specifically, the two Services have not yet agreed on the protocols to be used to support the agreed-to fire support messages in AFATDS. Further, the Services have different programs for standardizing data elements and other aspects of data management for tactical systems.

COURSES OF ACTION FOR ARMY AND MARINE CORPS

Both Services need to review their current specifications for the type and degree of automation needed to ensure that the appropriate level of detail for ADP support requirements is provided to system developers. The level of detail of the user specification of automation requirements varies greatly between the two Services and among the tactical data systems of each Service. Both Services should consider developing a system to prioritize requirements for each block improvement.

Both Services should continue to reassess the voice and data communications required to support tactical command and control as increasing ADP support is provided in the 1990s and beyond. Potentially, the assessments will lead to additional requirements on tactical data systems that will ensure these systems can operate effectively when fielded communications systems degrade or if enhanced communications systems are not fielded as planned.

As the Army and Marine Corps work together in multi-Service programs for maneuver control and fire support, they should consider the development of concepts that will also apply to the ADP support for Joint Task Force C2. Many of the elements of force-level control, maneuver control, and fire support for (Joint) combined arms operations and MAGTF C2 appear to be very similar to those required for Joint Task Force C2.

The Marine Corps needs to complete work on its revised concept for MTACCS and requirements specification for MAGTF C2 and the four functional areas. Specifically, detailed information exchange requirements are needed to define interfaces among tactical data systems within the functional areas (e.g., between FIREMAN and FIREFLEX) and among the functional areas (e.g., between ATACC and FIREFLEX). Further, the ROC for FIREMAN needs to approved, and the 1978 TCO ROC needs to be reviewed in relation to the revised MTACCS concept. Finally, detailed ADP functions need to be defined by the users to show the type and degree of automation that is to be developed for the tactical data systems in MTACCS.

COURSES OF ACTION FOR OSD

OSD could support Service initiatives that would lead to multi-Service programs to develop common systems for fire support, maneuver control, and a battlefield air picture. A multi-Service fire support program could lead to a common objective system for the Army's AFATDS and the Marine Corps' FIREFLEX with initial operational capability (IOC) in FY94. In addition, a multi-Service maneuver control program could lead to a common objective system for the Army's MCS and the Marine Corps' FIREMAN (and possibly TCO) in FY93. Finally, a multi-Service program could be developed to exploit the opportunities to acquire and distribute a battlefield air picture.

In addition, OSD could request that the Army and the Marine Corps provide briefings on the Service efforts to develop and expand multi-Service initiatives, to adopt common standards between the two Services, and to work together towards use of hardware and software common to both Services.

Finally, OSD could request DCA and JTC3A to take two actions that would improve progress toward interoperability. One would be to ensure that the Army and the Marine Corps quickly complete their discussions on the initial Joint information exchange standards to be used in AFATDS Version 1. Unless agreement is reached, the Services could rely on incompatible data communications protocols. A second action would be for DCA and JTC3A to develop a detailed, long-range plan to focus U.S. initiatives for enhancing civil standards for open systems interconnection for tactical use.

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PART 1

EXECUTIVE BRIEFING

The Executive Briefing begins with a statement of the objectives of the tasking given to IDA by OSD. This is followed by a summary of the findings and conclusions in five separate areas: system concepts, maneuver control, fire support, air operations for airspace coordination and control, and interoperability. The system concept assessment addresses issues that arose in the study that spanned more than one of the functional areas.

The summary provides a statement of the overall conclusions of the study. It also suggests courses of action that could be taken by the Army, Marine Corps, OSD, and DoD-wide agencies to address these conclusions.

Detailed information for each of the assessments summarized here is provided in Volume II, Part II--Technical Briefing. The sections and charts are subtitled in the same way in both Parts of the study to facilitate cross-referencing.

OUTLINE

- OBJECTIVES
- ASSESSMENTS
    1. System Concepts
    2. Maneuver Control
    3. Fire Support
    4. Air Operations for Airspace Coordination
    5. Interoperability
- SUMMARY

RPW-12-18-89-2

The objective of this study is to review Army and Marine Corps requirements in maneuver control, fire support, and air operations in order to identify options for incorporating existing and emerging systems of one Service for use by the other Service. The scope of air operations was limited to airspace coordination and control and the results focus on the concept of a battlefield air picture. In addition, IDA was asked to identify issues for interoperability that arise in the assessment.

Of specific interest to OSD were:

- Service evaluations of fire support systems, including the Army Concept Evaluation of the Advanced Field Artillery Tactical Data System (AFATDS)
- Army and Marine Corps airspace command and control requirements and systems such as the Marine Corps' Tactical Air Operations Module (TAOM), Advanced Tactical Air Command Center (ATACC), and Improved Direct Air Support Center (IDASC), and the Army's Tactical Airspace Integration System (TAIS)
- The Army's Maneuver Control System (MCS).

OBJECTIVES OF THE TASK

- REVIEW ARMY AND MARINE CORPS REQUIREMENTS FOR ADP SUPPORT OF:
  - -- Maneuver Control
  - -- Fire Support
  - -- Air Operations
- IDENTIFY OPTIONS FOR EXISTING AND EMERGING SYSTEMS OF ONE SERVICE TO BE USED BY THE OTHER
- CONTINUE WORK ON ARMY/MARINE CORPS JOINT INTEROPERABILITY ISSUES

RPW-12-18-89-3

This section summarizes the status of the major tactical C2 systems of both Services and summarizes the findings and conclusions that address issues spanning more than one functional area.

System Concept Assessment

1. SYSTEM CONCEPTS

- STATUS OF C2 CONTROL SYSTEMS
- FINDINGS
- CONCLUSIONS

RPW-12-18-89-4

This chart identifies the conceptual, developmental, and fielded tactical data systems that are planned to serve the role as functional area control systems within ATCCS and MTACCS.

The Army is simultaneously developing five functional area control systems, of which four will be fielded on ATCCS common hardware and software (CHS) (AFATDS, CSSCS, FAAD C2I, and MCS-CHS). AFATDS will replace the Tactical Fire Direction System (TACFIRE), and ASAS will replace the Technical Control and Analysis Center (TCAC) in units so equipped. The PATRIOT Information Coordination Central (ICC) and the AN/TSQ-73 MISSILE MINDER will continue to support high- and medium-altitude air defense (HIMAD) systems. MCS is planned to provide support of both force-level and maneuver control (eventually, all the control systems will have ADP support for force-level control).

The Marine Corps has substantial ADP only for its Aviation C2 systems. In support of Aviation C2, the IDASC is still conceptual, in that it has no ADP support, whereas the ATACC is developmental using nondevelopmental-item (NDI) equipment and some NDI software. The other elements [i.e., Marine Air Traffic Control and Landing System (MATCALS), TAOM] are fielded. The MAGTF C2 system, TCO, is still conceptual, although its ROC was promulgated in 1978. In support of Ground C2, FIREMAN (for maneuver control) is still conceptual, FIREFLEX is developmental (currently directed to AFATDS as the objective system), and the Position Location Reporting System (PLRS) is fielded. The Improved Force Automated Service Center (IFASC), Marine Integrated Personnel System (MIPS), and Marine Integrated Logistics System (MILOGS) are developmental CSS C2 systems that will provide interfaces to Continental United States-based systems, personnel information, and logistic information, respectively. The only fielded portion of MTACCS for Intelligence is Tactical Electronic Reconnaissance Processing and Evaluation System (TERPES); the Intelligence Analysis System (IAS) and the Joint Service Imagery Processing System (JSIPS) are developmental.

Highlighted in the chart with boxes are the systems identified by the IDA study team as primary candidates for cross-Service commonality. Three of the systems are in the CSS functional area: CSSCS, MILOGS, and MIPS. Since assessment of ADP support for combat service support is outside the scope of the current task, opportunities for exploiting commonality of these systems were not further considered in the IDA study.

The potential for commonality for maneuver control and force level control systems (TCO, MCS, FIREMAN) is addressed in the maneuver control assessment that follows this section. The fire support assessment addresses the potential for commonality for AFATDS and FIREFLEX. IDASC is addressed in the discussion of air operations, but it can also benefit from use of ADP capabilities discussed for maneuver and fire support .

System Concept Assessment

STATUS OF MAJOR C2 SYSTEMS FOR ARMY AND MARINE CORPS

	CONCEPTUAL WITH TESTBED PROTOTYPES	DEVELOPMENTAL (ESTIMATED IOC)	FIELDED
ARMY		• AFATDS (FY94)	MCS-TCT/TCP
		ASAS (LCC FY93)	PATRIOT ICC
		• CSSCS (FY94)	TACFIRE
		• FAAD C2I (FY94)	TCAC
		• MCS-CHS (FY93)	TSQ-73 (HAWK C2)
MARINE CORPS	○ FIREMAN[1]	ATACC (FY92)	MATCALS
	○ TCO	• FIREFLEX/AFATDS (FY94)	PLRS
	IDASC	IAS[1]	TAOM
		IFASC	TCAC
		JSIPS	TERPES
		* MILOGS[1]	
		* MIPS[1]	

Key: • Plans to use Army CHS
* Plans to use FMF EUC
○ Both Army CHS and FMF EUC are being considered
▭ Systems where subsystem commonality has the greatest potential across the Services

1 Draft ROCs have not yet been approved.

RPW-12-18-89-5

A review of the current descriptions of ATCCS and MTACCS shows that these system-of-systems concepts could provide a sound foundation for developing ADP support for tactical operations. The two Services have plans at different stages of implementation to address four key areas in approximately the same way. Both Services plan to:

- Use common nondevelopmental item hardware and common, modular, and layered software for the major control systems in each of the functional areas. The Army has selected an initial set of CHS and developmental programs are in place to use the CHS for AFATDS, CSSCS, FAAD C2I, and MCS. The Marine Corps has an End User Computer Equipment (EUCE) and a Down-sized End User Computer Equipment (DEUCE) with development for software to support MIPS and MILOGS. The objective system software for FIREFLEX will be AFATDS; ATCCS CHS is being considered for FIREFLEX. Many of the elements of the layered software approach for MTACCS are still to be determined.
- Address requirements for Joint interoperability with other Services and Combined interoperability with the Allies, as well as interoperability among the tactical data systems of each Service. However, in some cases, implementation of Joint and Combined interoperability is related to later stages of the development of the tactical data systems. Both Services have stand-alone ADP support for JINTACCS messages, but this capability is not planned to be integrated into the databases of most of the tactical data systems. Most interfaces between the major C2 systems of common functional areas of the Army and Marine Corps are still not defined. Not all of the required interfaces to major C2 systems of the Allies will be in place when the Army and Marine Corps systems are initially fielded.
- Emphasize a high-level, common-user database and implement support for cross-functional information exchange. Both Services plan to implement a Commander's database and cross-functional information exchange as part of force-level control concepts. While these capabilities may initially be fielded in a single tactical data systems (in MCS for the Army and TCO for the Marine Corps), they are planned to be expanded by use of common software modules to tactical data systems of other functional areas. However, the initial implementations will involve manual swivel-chair interfaces and physical exchange of storage media--automated support of cross-functional information exchange is not planned by the Army until 1995 (MCS Version 12) and is to be determined in the Marine Corps.
- Develop modules of common application support software (CASS) that can be used, eventually, by most or all of the major tactical data systems. This approach could, in the long-term, reduce duplication of developmental software and thereby lead to substantial cost savings. Further, use of common software for database interactions, information exchange, and data communications protocols could lead to enhanced interoperability.

System Concept Assessment

FINDINGS

- **ATCCS AND REVISED MTACCS PROVIDE SOUND FOUNDATION FOR DEVELOPING ARMY AND MARINE CORPS ADP SUPPORT FOR TACTICAL OPERATIONS**
  - -- Each Service plans to use common NDI hardware and common, modular, and layered software
  - -- In some cases, joint and combined interoperability is relegated to later stages of evolutionary development
  - -- Each emphasizes a high-level database and cross-functional information exchange
  - -- Common applications support software could lead to substantial cost savings and enhanced interoperability

RPW-12-18-89-6

ATCCS and MTACCS concepts provide more opportunities to improve intra-Service interoperability and reduce acquisition costs than would be expected without a system-of-systems concept. These opportunities result from the use of common nondevelopmental hardware and software; developing applications software, where possible, for use by more than one system; emphasizing modular and incremental development; and implementing high-level, common-user databases to support information exchange. Systems that exploit these approaches can be developed at an overall reduced cost and simplify support of interoperability requirements.

One key drawback in the current plans for ATCCS and MTACCS is that the planned tactical data systems will not provide automated support of cross-functional information exchange until later stages of the evolutionary development. Manual and swivel-chair interfaces will be required for force-level control in MCS until the mid-1990s (the schedule for the Marine Corps' objective TCO is still to be determined).

System Concept Assessment

CONCLUSIONS

- ATCCS AND MTACCS PROVIDE OPPORTUNITIES TO IMPROVE INTRA-SERVICE INTEROPERABILITY AND REDUCE ACQUISITION COSTS

- AS PLANNED NOW, AUTOMATED INFORMATION EXCHANGE ACROSS FUNCTIONAL AREAS FOR ARMY WILL NOT BE ACHIEVED BEFORE MID-1990s (TBD FOR MARINE CORPS)

RPW-12-18-89-7

The maneuver control assessment began with a comprehensive review of the requirements in the Army and the Marine Corps. The result of combining these requirements is provided in Volume II, Appendix A. The degree of commonality of these requirements is described in Volume II, Appendix B and summarized in this section. Nine driving requirements were identified by the IDA study team, and these were used to assess the major system options--the results of that assessment are provided in this section. These are followed by a brief statement of the findings and conclusions.

Maneuver Control Assessment

2. MANEUVER CONTROL

- CONSOLIDATED REQUIREMENTS
- ASSESSMENT OF SYSTEM OPTIONS
- FINDINGS
- CONCLUSIONS

RPW-12-18-89-8

The stated requirements contained in the ROCs for maneuver and force-level control of the Army and the Marine Corps were reviewed, integrated, and compared with other statements of requirements (the result is provided in Volume II, Appendix A). The MCS, TCO, and FIREMAN ROCs were the main sources of these requirements. A substantial commonality of requirements was observed between the requirements of the two Services and listed in a consolidated generic capability document (the result is provided as Appendix B in Volume II). This chart summarizes the results of that analysis.

The Services plan to support maneuver control and force level control primarily by providing ADP support for information exchange and a common-user database. All of the specified functions are associated with deriving, manipulating, and displaying information that is maintained in the database. To support decisionmaking by the Commander and assessments by the Commander's staff, a high-level database is provided and maintained at the operations centers. This high-level database is planned to be accessible to and updated from other tactical data systems. More detailed information is planned for the common-user database maintained elsewhere for other staff functions and for functions specific to one of the functional areas.

Both Services are fielding systems that will provide position location information (PLI) that is critical to effective use of maneuver forces. The Position Location Reporting System (PLRS) was developed and fielded by the Marine Corps. The Enhanced Position Location Reporting System (EPLRS) is being developed by the Army to extend the communications capability of PLRS; EPLRS is planned to be fielded in the Army beginning in FY93.

The database is required to support automatic updates and to be capable of receiving, transmitting, editing, storing, and retrieving information as text, printed copy, graphics, and overlays. Updates and access to the database are to be selectively controlled, and ad hoc queries are to be supported.

Further, the system is to be designed to facilitate continuity of operations (e.g., echeloning, jump command posts, coordination among forward, rear, and main command posts) and to degrade gracefully when portions of the system or supporting communications become unavailable.

Finally, both Services require interoperability among systems in the maneuver control or Ground C2 functional areas, with systems of other functional areas of the same Service, and for Joint and Combined operations.

Maneuver Control Assessment

CONSOLIDATED REQUIREMENTS--SUMMARY

- DERIVED FROM COMBINED REQUIREMENTS OF MCS, TCO, AND FIREMAN ROCs

- SUMMARY

  (1) Provide a common-user database with automatic update, capable of receiving, transmitting, editing, storing, and displaying information (including messages) as text, printed copy, graphics, and overlays

  (2) Provide selective control update and access to database and support ad hoc queries

  (3) Provide for continuity of operations and graceful degradation of capabilities

  (4) Provide interoperability

RPW-12-18-89-9

The left side of this chart briefly identifies the nine driving requirements. Driving requirements are those derived by the IDA study team from the consolidated generic capability that appeared to be both essential to the operation of a maneuver control system at its initial fielding and also to be key elements in the evaluation of system options for an objective system. The nine driving requirements are:

(1) Provide the capability to prepare, receive, transmit, store, retrieve, print, and display information to include messages, graphics, and overlays

(2) Provide a common-user database that supports automatic update from information transfer

(3) Support information transfer over existing communications systems and provide for use of planned communications

(4) Provide summary and detailed information for resource status of subordinate units (roll-up reports)

(5) Support continuity of operations (CONOPS)

(6) Provide equipment easily transportable by the using unit

(7) Support automated cross-functional information exchange

(8) Support Joint interoperability and provide growth for Combined interoperability

(9) Provide an automated interface for and integrate position location information (PLI).

Careful review of the Service's evolutionary acquisition plans shows that not all of these requirements are being given the same priority. As shown in the chart, three of the driving requirements have been assessed by the IDA study team as being of somewhat lower priority than the others--this assessment was based on the fact that both Services have development plans to implement automated support for these requirements in later stages of system evolution. All but Requirement 7 is specified by the Marine Corps for both TCO and FIREMAN.

The current version (V10.2) of MCS supports Requirements 1, 3, and 4, and the next release (V10.3) in 1990 will also support Requirements 2 and 5. The Tactical Computer Terminal (TCT) and Tactical Computer Processor (TCP) are very heavy (TCP weighs 844 pounds). More easily transported equipment will not be provided until MCS Version 11 with the ATCCS CHS in 1993 (however, ATCCS CHS workstations with printer and modem will weigh 250 pounds or more). The MCS program has specific plans to implement the Priority 2 requirements in later versions of MCS (V12 to be fielded in FY95 and V13 to be fielded in FY97).

FMF Initiatives already support three of the requirements (1, 3, and 6), but, without a major change in development plans, do not appear to be capable of supporting the common-user database with automatic update from exchanged information, to provide roll-up and other types of resource summaries directly from a database, nor to provide database continuity when portions of command posts are relocated. Of the Priority 2 requirements, only the last is explicitly called out as a preplanned product improvement (P3I)--interface between PLRS user units and personal computers has been demonstrated by the Marine Corps.

Maneuver Control Assessment

ASSESSMENT OF SYSTEM OPTIONS FOR PROVIDING ADP SUPPORT TO MANEUVER CONTROL

POTENTIAL DRIVING REQUIREMENT	ASSESSED PRIORITY	PROVIDED BY MCS	PROVIDED BY FMF INIT	REQUIRED FOR
1. MANAGES, DISPLAYS, PRINTS INFORMATION	1	V10	Yes	TCO, FIREMAN
2. PROVIDES DATABASE W/ AUTO UPDATE	1	V10	No	TCO, FIREMAN
3. USES EXISTING AND PLANNED COMM	1	V10	Yes	TCO, FIREMAN
4. PROVIDES RESOURCE ROLL UP REPORTS	1	V10	No	TCO, FIREMAN
5. SUPPORTS CONOPS	1	V10	No	TCO, FIREMAN
6. PROVIDES EASILY TRANSPORTED EQUIPMENT	1	V11-CHS	Yes	TCO, FIREMAN
7. SUPPORTS AUTO CROSS-FUNC INFO EXCH	2	V12	No	TCO
8. SUPPORTS JOINT INTEROPERABILITY	2	V12	No	TCO, FIREMAN
9. INTEGRATES AVAILABLE PLI	2	V13	P3I	TCO, FIREMAN

Notes: a. MCS V10.2 has been fielded on TCTs and TCPs.
b. MCS V10.3 is being developed for fielding on TCTs/TCPs in 1990.
c. MCS V11 is being developed for fielding on CHS as well as TCTs/TCPs in 1993.
d. MCS V12 is planned for FY95, and MCS V13 is planned for FY97.

RPW-12-18-89-10

The study identified a number of issues that need to be addressed by the Marine Corps before a comprehensive strategy can be expected for meeting maneuver control requirements. These include defining the specific functions that need to be automated to support planning, evaluation, and decision making; degree of ruggedization; size and weight limits; specific information exchange requirements; and communications requirements.

However, there are a number of goals that could be achieved by the two Services if work is started early on a multi-Service research and development (R&D) program for maneuver control:

- Both Services could work to field the same system. Service-unique aspects could be addressed by planning for differences in the content of the databases and configurations.
- The initial fielding of an objective FIREMAN or TCO system for the Marine Corps could be based on MCS V11 software and ATCCS CHS.
- The design of the Commander's Database in MCS could be modified to meet the requirements of both Services.
- The Services could work together to procure a lightweight workstation, such as a laptop computer, to meet requirements of both Services in highly mobile units.
- An automated interface could be developed (possibly in time for Version 11) for the PLI in PLRS and EPLRS. The Marine Corps has already demonstrated some concepts for such an interface.
- The Services could work together to address requirements for automated cross-functional exchange, Joint interoperability, and Combined interoperability. Joint interoperability could be based on extending the JINTACCS K-Series messages now being developed for fire support. Combined interoperability could be initially based on the work already underway in the Quadrilateral Interoperability Program. Concepts for automating support of cross-functional interoperability (e.g., between MCS and AFATDS) would be explored (for MCS Version 11 and AFATDS Version 1).

Maneuver Control Assessment

FINDINGS

- **MARINE CORPS NEEDS TO RESOLVE A NUMBER OF REQUIREMENTS ISSUES BEFORE A COMPREHENSIVE R&D STRATEGY CAN BE DEFINED**

- **ACTIVE MARINE CORPS PARTICIPATION IN ARMY'S MCS PROGRAM COULD LEAD TO:**
  - **Both Services working to field the same system**
  - **Initial fielding for Marine Corps based on MCS Version 11 and ATCCS CHS**
  - **Modifying design of Commander's Database, if necessary, to meet the requirements of both Services**
  - **Procuring lightweight workstations (e.g., laptop computers) as NDI and fielding by Services in highly mobile units**
  - **Developing an automated interface to the PLI in PLRS/EPLRS**
  - **The Services working together to address automated cross-functional, Joint, and Combined Interoperability requirements**

RPW-12-18-89-11

Both the Army and the Marine Corps have essentially the same basic requirements for ADP support of maneuver control.

The FMF Initiatives address some, but not all, of the driving requirements identified in this assessment. The FMF initiatives are not considered by the IDA study team as a satisfactory foundation for building an objective system for either FIREMAN or TCO. Specifically, these initiatives do not provide for a common-user database with the capability to provide the required functions, and addressing this deficiency would constitute a major program change and possibly lead to a significant investment.

The Army's MCS, however, with modifications, appears to be a viable system option for FIREMAN and, eventually, TCO. The Army has already made major investments in this program, and the redesign planned for MCS Version 11 and ported to the ATCCS CHS would satisfy all the Priority 1 driving requirements of both Services. The commonality of requirements and the potential of MCS Version 11 could lead the Marine Corps to an early decision to begin formal participation in a multi-Service program with the Army. Both PM MAGTF C2 and PM OPTADS have indicated to the IDA study team that detailed discussions are already underway for Marine Corps participation in MCS. The Services plan to discuss a draft Memorandum of Agreement early in 1990.

Maneuver Control Assessment

CONCLUSIONS

- BOTH SERVICES HAVE ESSENTIALLY THE SAME BASIC REQUIREMENTS FOR MANEUVER CONTROL ADP C2 SUPPORT
- FMF INITIATIVES ADDRESS SOME BUT NOT ALL DRIVING REQUIREMENTS AND ARE NOT CONSIDERED SATISFACTORY AS A FOUNDATION FOR BUILDING AN OBJECTIVE SYSTEM
- MCS, WITH MODIFICATIONS, APPEARS TO BE A VIABLE SYSTEM OPTION FOR FIREMAN AND, EVENTUALLY, TCO

RPW-12-28-89-12

This section begins with a summary of the status of the fire support programs of the Army and the Marine Corps (AFATDS and FIREFLEX, respectively). Since IDA has recently assessed the fire support requirements of both Services and analyzed system options for each Service to use the developments of the other, the assessment summarized in the findings and conclusions is based on a review of the multi-Service program that is currently underway for AFATDS and FIREFLEX.

Fire Support Assessment

3. FIRE SUPPORT

- STATUS OF AFATDS
- STATUS OF FIREFLEX
- FINDINGS
- CONCLUSIONS

RPW-12-18-89-13

The Army began the Concept Evaluation (CE) phase of AFATDS in 1984 and concluded it in 1989 with CE testing at Fort Sill. This testing and evaluation noted that the CE system had a very low error rate (no Priority 1 or 2 errors and less than 15 percent of the allowed number of lower priority errors) and identified the need to improve status information in fire support execution, time required for fire support planning, and reinitialization of the LAN (for continuity of operations).

In July 1989, the Army Systems Acquisition Review Council (ASARC) made a Milestone II decision to proceed with full-scale development (FSD). This decision was ratified by the OSD Conventional Systems Committee and the Defense Acquisition Board (DAB). The main OSD issue was the acceptability of the proposed maintenance concept, and the Army has stated that this is under reconsideration. A final Program Baseline was approved by the Army and OSD in October 1989, at which time the Defense Acquisition Executive authorized the Army tc proceed with FSD. This authorization also stated that at Milestone III, OSD will ". . . review AFATDS for adequate Marine Corps functional integration."

IOC for AFATDS is now planned for March 1994, allowing approximately 4 years to port the CE software to the ATCCS CHS, complete the systems engineering, and develop the new software required for comparability with TACFIRE capabilities. The system specification for Version 1 is complete and is now undergoing review to specify items previously left to be determined. Standard Integrated Command Post System (SICPS) shelters will be used. The FSD contract is expected to be negotiated with the CE contractor (Magnavox Electronic Systems) early in 1990. Initial operational capability (IOC) is planned for March 1994 and first unit equipped (FUE) in February 1993.

AFATDS is now a multi-Service program that could lead to a system that could be fielded by both the Army and the Marine Corps. It is possible that the IOC software could be identical for the Services, with differences in the implementation of the database and the initialization data that would invoke specific features and activate modules of software for the nodes at system initialization. Software used by only one Service could be left inactive and invisible to users of the other Service. The two Services have agreed in the MOA to implement Joint interoperability in Version 1 AFATDS, but details of the protocol to be used with the agreed-to messages are still not settled.

A Memorandum of Agreement (MOA) was signed by two Service PEOs (MGen Kind and MGen Franklin) in June 1989 to identify Service initiatives to make the program for AFATDS a multi-Service program. MCRDAC provided $2.0 M in FY89 to initiate a task order to support Marine Corps objectives. OSD has supported the two Services' initiatives to obtain additional FY89 and FY90 funds ($2.0 M each year) for the Marine Corps to participate in AFATDS; however, the agreements required to release the FY90 funds already identified are not yet complete.

Fire Support Assessment

STATUS OF AFATDS

- CONCEPT EVALUATION SATISFACTORILY COMPLETED
- ASARC AND DAB MILESTONES COMPLETED
- IOC PLANNED FOR MAR 1994 (FUE IS FEB 1993)
- NOW A MULTI-SERVICE PROGRAM
  - -- MOA signed by PEOs
  - -- Multi-Service AFATDS funded by both Services
  - -- OSD supported Service efforts to obtain additional funds ($2M FY89, $2M FY90) for Marine Corps participation

RPW 12-18-89-14

The Marine Corps has a validated ROC for FIREFLEX (approved April 1989) and has structured the R&D program for FIREFLEX based mainly on participating in AFATDS. As agreed in the MOA, the Marine Corps is providing on-site representation in the Office of the Program Manager (OPM) Field Artillery Tactical Data Systems (FATDS). Due to staffing problems within the Marine Corps, this representation has become intermittent. However, the Marine Corps now has approved plans to provide as many as three full-time representatives to programs at Fort Monmouth, including one at OPM FATDS. The Services are planning an FMF demonstration of AFATDS for the Marine Corps in February 1990. The demonstration will be conducted at Camp Pendleton using personnel at the Fire Marine Expeditional Force (I MEF).

The Marine Corps expects to continue the user involvement begun in 1989 by expanding the fire support testbed to all three MEFs for training, exercise, and demonstration. Equipment includes the BCS, MDS, AN/TPQ-36 FIREFINDER, PLRS, and DCT. Formal appraisals of concepts for modified LTACFIRE and modified FIST DMD were conducted in the second quarter of FY89. The Marines are using both Marine and Army protocols for the DCT, the former for Marine Corps intraoperability and the latter for interoperability with the TACFIRE-based systems (BCS, MDS, and FIREFINDER). Army CHS will be added to the testbed, together with prototype software for fire support (and other functional areas) whenever the software becomes available.

Fire Support Assessment

STATUS OF FIREFLEX

- **ROC NOW VALIDATED**
- **MARINE CORPS R&D PROGRAM BASED MAINLY ON PARTICIPATION IN AFATDS**
  - **On-site representation with OPM FATDS at Fort Monmouth (intermittent)**
  - **I MEF demonstration planned for Feb 1990**
- **FIREFLEX TESTBED WILL CONTINUE ACTIVE FMF INVOLVEMENT IN ADP C2 SUPPORT FOR FIRE SUPPORT**
  - **Appraisals for Modified LTACFIRE and Modified FIST DMD completed**
  - **Equipment includes FIST DMDs and LTACFIRE BCTs for all three MEFs**
  - **Army CHS to be added**

RPW 12-18-89-15

By participating in AFATDS as early as FY89, the Marine Corps can obtain a version of AFATDS that can meet their requirements for an objective FIREFLEX system at a low additional investment. The Army and the Marine Corps are seeking to add to the current AFATDS specification provisions to ensure that the Version 1 system will be operationally suitable for both Services. For the Marine Corps, this means extending the human-machine interface and possibly the database to support doctrine, task organization, and other special characteristics. It is hoped that the special characteristics can be achieved by varying the data used by the Services at initialization. In addition, the Marine Corps and the Army have agreed to add the Marine Tactical System (MTS) fire support messages and protocols (both broadcast and switched) in Version 1 to support interoperability with the fielded DCT and other MTACCS systems. Finally, the Services have reached agreement on the data element dictionary, messages, and message syntax for Joint interoperability between fielded AFATDS systems of the two Services.

Work still needs to be done to reach agreement on the protocols to be used to transmit the agreed-to fire support messages for Joint interoperability. JTC3A has recommended to OSD that the MTS protocols be used for this purpose. The Army is seeking to expand the services provided by the protocols (otherwise these services, such as relay, would have to continue to be handled by the application software in AFATDS). Even if no additional services are agreed to for Version 1 AFATDS, it appears that some modification of the MTS protocols would be needed to support all the features of the agreed-to message syntax (alternatively, the message syntax could be modified, but the result would be significantly less useful in Service applications for other than this specific interface).

Further, the Services need to soon begin to develop the detailed specifications for the ADP support to be provided in Version 2 of AFATDS, specifically for functions such as support of naval gunfire (NGF) and close air support (CAS). Version 1 AFATDS will provide weapons effectiveness tables for naval guns and will identify targets for which CAS is the preferred fire support means, but these areas need to be significantly expanded. However, the detailed requirements have not yet been developed by the users of either Service.

Common applications support software (CASS) is an initiative that could have major benefits to both Services in achieving stated objectives and lowering the long-term developmental, procurement, and maintenance costs of currently planned tactical data systems. However, if the Services want to maintain the schedules contained in the program baselines for AFATDS, FAAD C2I, and MCS, the scope and management of CASS development needs to be carefully controlled. Without effective management, the drive to develop as much CASS as possible will lead to increased schedule risk for all three systems, but specifically for AFATDS. Key management practices would include limiting the scope of CASS modules; specifying the functionality, design, interfaces, and technical features early; obtaining agreement and support among the PMs for specific initiatives; developing and maintaining realistic schedules; getting documentation, specifically for the software interfaces, under configuration control early in the development; and providing adequate resources of expert personnel, time, technical support, and equipment for configuration management and conformance testing.

Fire Support Assessment

FINDINGS

- EARLY MARINE CORPS PARTICIPATION IN AFATDS WILL LEAD TO AN OBJECTIVE FIREFLEX SYSTEM AT LOW ADDITIONAL INVESTMENT

- WORK STILL NEEDS TO BE DONE:
  - To complete the Joint interface specification
  - To identify specific ADP support specifications for CAS and NGF

- EFFORTS TO CREATE AND IMPLEMENT CASS FOR MCS, FAAD C2I, AND AFATDS SIMULTANEOUSLY COULD CREATE A SCHEDULE RISK FOR AFATDS

RPW 12-18-89-16

By moving forward with an MOA and funding a multi-Service program, the Services have agreed that AFATDS can be developed to meet the needs of both Services. The multi-Service program is already underway. The goal of a single version of software for Version 1 appears to be achievable and potentially suitable for both Services. However, substantial work needs to be done by both Services to develop detailed specifications for ADP support of close air support and naval gunfire for the Version 2 software development that is scheduled to begin early in 1991.

The Army and the Marine Corps need to finish their work shortly on specifying the standards to be used for the Joint fire support interfaces, in order to meet the schedule for AFATDS Version 1. The Army may have to defer some of their priority requirements for additional services in the data communications protocols, and the Marine Corps may need to modify the MTS standard to avoid having two sets of protocols and messages for fire support, if the Joint protocol is to be used by the Services for other than this specific interface. Since the Marine Corps has a significant investment in the current MTS, modifying MTS in all sets of DCT software and the implementations in other MTACCS systems would not be cost effective unless the Joint protocol is to be used more widely than for AFATDS-to-AFATDS exchanges.

The schedule provided by the Army for the AFATDS program baseline now provides sufficient time to complete the porting, system engineering activities, and new software development without high schedule risk. However, the IOC for AFATDS for heavy Army divisions has slipped 3 years (from FY91 to FY94) during the last 3 years (November 1986 to December 1989). Further slips could jeopardize the program, and schedule risks must therefore be kept very low. Specifically, the CASS initiatives need to be carefully managed to avoid creating a new schedule risk for AFATDS.

As soon as the plans are approved, the Marine Corps needs to provide details of their funding profiles and procurement strategy to support fielding of AFATDS. These plans should show the support for short- and long-term participation in the multi-Service development and testing program, as well as the funding required to complete procurement. Unless there are substantiated unmet requirements for ruggedization or lower-cost options, the acquisition of the IOC version of FIREFLEX should be based on AFATDS Version 1 and the ATCCS CHS.

Fire Support Assessment

CONCLUSIONS

- AFATDS CAN BE DEVELOPED TO MEET THE NEEDS OF BOTH SERVICES
- SERVICES NEED TO COMPLETE WORK ON JOINT INTERFACE STANDARD SOON TO MEET SCHEDULE FOR VERSION I
- EFFORTS TO MAXIMIZE ATCCS COMMON APPLICATION SUPPORT SOFTWARE COULD CREATE A SCHEDULE RISK
- PLAN FOR MARINE CORPS' ACQUISITION OF AFATDS NEEDS TO BE COMPLETED AND PROVIDED TO OSD

RPW 12-18-89-17

This section begins with background that provides the operational context for the increasing challenge in managing airborne force elements and explains the concept of a battlefield air picture. This background is followed by a summary of the potential use of the battlefield air picture in C2 systems. The section ends with a summary of the findings and conclusions.

The air operations assessment was originally focused in the Task Order on airspace coordination and control. At the midterm briefing to OSD, it was agreed to focus on the concept of a battlefield air picture, one that provides airspace coordination information for use in supporting land warfare functions other than the control and employment of air defense surface-to-air missiles.

A battlefield or "mud" air picture is defined as a correlated display of aircraft positional and identification information overlaying battlefield graphics and appropriate unit locations as available. A mud air picture as envisioned would consist of the following features:

- Inputs from multiple sensors that have been correlated and identified as air track information
- Other positional inputs, to include voice-manual [e.g., from the Global Positioning System (GPS)] or electronic (e.g., from PLRS) information.
- Battlefield graphics to show unit boundaries and locations, where appropriate, and fire support and airspace control coordination measures.

Air Operations Assessment

4. AIR OPERATIONS FOR AIRSPACE COORDINATION

SCOPE: FOCUS ON BATTLEFIELD ("MUD") AIR PICTURE

- BACKGROUND
- POTENTIAL USE
- FINDINGS
- CONCLUSIONS

RPW 12-18-89-18

A battlefield or mud air picture could be a key element to integrated and combined arms operations common to both the Army and Marine Corps. Mobility and maneuver, including over-the-horizon operations, will be major factors in future battles whether against first-line Soviet or Third World forces. Consequently, the scope of the battlefield and associated areas of operations and interest will be larger.

The future battle will require strenuous efforts to keep the Commander and staff oriented, not just informed, as to friendly and enemy situations. A three-dimensional battlefield picture is needed to take advantage of enemy positional weaknesses and to avoid falling into a reactive mode.

Surface and airborne force elements will move faster over future battlefields. For example, the M1A1 tank can dash at speeds comparable to helicopters maneuvering in nap-of-the-earth terrain flight. The Landing Craft, Air-Cushioned (LCAC) can move in air-cushioned flight at 40 knots, and new technology helicopters capable of both air-to-ground and air-to-air weapon engagements can move upwards of 180 knots. Tilt-rotor air platforms, enemy or friendly, could carry troops and weapons at speeds of 200-300 knots. New fast moving aspects of the future battlefield will be significantly different from past situations where visual contact was possible or where overall relatively slow movement of enemy or friendly forces could be tracked or predicted.

Management or control of surface-force movements and airspace immediately over the battlefield is today mostly procedural. Fire support coordination and maneuver are based on planned missions and positions and on positional information that is not real-time or near-real-time. An on-call field artillery fire mission within the vicinity of low flying aircraft frequently needs coordination among several activities at different organizational levels. The inherent delay in procedural coordination varies, but that delay results in reduced fire support effectiveness. If an FSE or FSCC were observing a real-time battlefield air picture, there need not be any coordination delay as fire support coordinators would know when fires could be delivered without endangering aircraft, and aircraft crews would know that flight paths would not be subject to friendly fires. Thus, an available near-real-time air picture could reduce reliance on time-consuming procedural coordination and provide improved orientation on status of forces to support more effective maneuver.

Operations at night and in adverse weather are noted for being difficult and significantly slower in tempo. Degraded visual orientation results in an increased use of procedural controls. With a low-altitude air picture available for night and adverse weather operations control, the tempo could be significantly increased.

Beginning in 1986, Joint doctrine (JCS Pub 26) recognized an active air defense mission for helicopters equipped with self-protection air-to-air weapons. This is due, in part, to the increasing threat from VTOL aircraft such as HIND, HAVOC, and HOCUM. Successful counterair operations are recognized to depend on situation awareness by the aviator, control of the air battle, and effective airspace control.

Air Operations Assessment

BACKGROUND FOR BATTLEFIELD AIR PICTURE

- **NEED FOR IMPROVED BATTLEFIELD ORIENTATION DUE TO:**
  - **Expanded area of interest to Land Warfare Commander**
  - **Inadequate low-altitude radar coverage**
  - **Greater use of air mobile and airborne maneuver forces**
  - **Greatly reduced time for identifying potential conflicts and completing airspace coordination as the maneuver force's mobility, range, and speed are increased**
  - **Exploiting air mobility at night and in degraded weather conditions**
  - **Low-altitude counterair operations against VTOL threat**

RPW 12-18-89-19

Current uses of an air picture for the Army and Marine Corps involve primarily air defense surface-to-air missile (SAM) and fixed-wing counterair operations. These are supported by the AN/TPQ-73 MISSILE MINDER for HAWK C2 and the PATRIOT Information Coordination Central (ICC) for PATRIOT C2. Additionally, the Marine Air Traffic Control and Landing System (MATCALS) uses a radar air picture for air traffic services to control aircraft approach and provide terminal control. For many years, the Marine Corps has had tactical data systems to support the Tactical Air Command Central (TACC): AN/TYQ-1 and AN/TYQ-3A. These will be replaced by the developmental Advanced Tactical Air Command Central (ATACC). Finally, the Joint program of the Marine Corps and the Air Force has completed development of the Tactical Air Operations Module (TAOM) and the Modular Control Equipment (MCE). The TAOM is being fielded to the Tactical Air Operations Center (TAOC) to support conduct of HIMAD C2 with HAWK units. It also supports navigation and air traffic control. The MCE has nearly the same functionality as the TAOM, except that the Air Force passes correlated radar tracks to the MCE, whereas the Marine Corps passes raw radar information to the TAOM for correlation.

Neither Service currently has ADP C2 support for low-altitude air defense (LAAD), although, as previously discussed, the FAAD C2I program will address this area for the Army. Further, neither Service has yet developed ADP C2 support for the nodes that perform airspace coordination: A2C2 and the DASC. The IDASC has a switchboard developed in the MIFASS program, but no automation support. There is also no automation or even electronic control capability in the Army's Flight Operations Centers (FOCs) and Flight Control Centers (FCCs). The TAIS program is designed to support the FOCs and FCCs, but there are no specific development plans. FAAD C2I is being examined for the TAIS and already plans to provide a subsystem to the A2C2. In addition, the Army is exploring concepts for a HIMAD C2IE module that can control SAM engagement operations for both HAWK and PATRIOT systems [examples are the Command Post Automated System concepts being developed at PM ADCCS and the SAM Operations Center (SAMOC) concept being developed with the Federal Republic of Germany by the U.S. Army Air Defense Artillery School].

Since the A2C2, TAIS, IDASC, and LAAD provide no automation support today for C2, these C2IE elements and systems would be the major potential users that would benefit from access to a battlefield air picture. The Army is already planning a low altitude or "mud" air picture for FAAD C2I and specifically for the A2C2 cells at division and brigade. Air picture support for Army's air traffic service FOCs and FCCs could also be met, eventually, by the FAAD C2I air picture. However, as will be shown in charts that follow, an interim capability for a battlefield air picture for these C2IE elements could be provided before FAAD C2I IOC without a major investment.

Air Operations Assessment

USES OF AIR PICTURE IN C2 SYSTEMS

	CONCEPTUAL	DEVELOPMENTAL	FIELDED
Army:	• A2C2 Support (airspace coordination) • TAIS (air traffic services, aircraft terminal control)	• FAAD C2I (ABMOC and low-altitude air defense units)	• HAWK TPQ-73 (HIMAD) • PATRIOT ICC (HIMAD)
Marine Corps:	• IDASC Automation (air support coordination) • LAAD (low altitude air defense)	• ATACC (command and control)	• MATCALS (approach and terminal control) • TACC (command and control) • TAOM for TAOC (air defense, navigation, and air traffic control)

MAJOR POTENTIAL USERS

RPW 12-18-89-20

Both Services are evaluating concepts for using an integrated air-ground situation display for fire support coordination, air traffic control (ATC), and other aspects of airspace coordination and integration (e.g., deconfliction). The Marine Corps developed a significant capability for this in MIFASS (perhaps the most successful part of the MIFASS program) as the Dynamic Situation Display (DSD). Requirements for this capability were not included in the ROC for the follow-on concept, FIREFLEX.

In reviewing the Army and Marine Corps ROCs and O&O plans, there were found only implicit air space coordination and control requirements related to providing ADP support associated with an air picture. However, Army concepts for a Tactical Airspace Integration System (TAIS) specify a need for an air picture and situation display. Further, Army Airspace Command and Control doctrine calls for coordination using information that would be provided in a battlefield air picture, and the Combined Arms Center (CAC) developed a concept for an air picture demonstration.[1] The Army methods of airspace control also refer to both a radar and nonradar environment, with the need expressed to be able to exercise positive control favoring a radar environment. The Marine Corps indicates no air picture requirements for the DASC; however, conversations with aviation C2 representatives do indicate a need for a DASC air picture. In addition, the NATO Air Command and Control System (ACCS) has a requirement for developing and distributing a Recognized Air Picture that includes coordination measures and which could be provided to the corps of the nations.

A battlefield air picture will improve tactical C2 for the Commander in two ways: First, it will significantly improve the battlefield orientation for the Commander and the Commander's Staff (e.g., adding the third dimension). Second, it would improve the Commander's capability to control maneuver and fire support resources. Further, airspace coordination for both the Army and the Marine Corps would be significantly enhanced by an integrated air picture for the agencies (A2C2 cell and the DASC) with this responsibility.

Providing support for a battlefield air picture would not necessarily require a major investment. Access to existing forms of air picture data could be displayed on stand-alone devices. Some could be considered for later integration with Service CHS. Examples of opportunities to improve the air picture include:

- Provide TADIL A access
- Providing wider distribution of air track data available in current (e.g., AN/TSQ-73, TACC, TAOM) and future (e.g., FAAD C2I) systems
- Increase the availability and use of PLI
- Field additional sensors, not only ground-based radars but airborne sensors (e.g., AWACS, VTOL-borne radars, RPVs).
- Address the broad land warfare requirements for a battlefield air picture when developing concepts for a highly mobile C2 module to replace current air defense C2 systems.

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[1] Briefing on Army Airspace Command and Control (A2C2) Air Picture Analysis, U.S. Army Combined Arms Center, 1986.

Air Operations Assessment

FINDINGS

- BOTH SERVICES EVALUATING CONCEPTS FOR USING INTEGRATED AIR-GROUND SITUATION DISPLAY FOR:
  - Fire support coordination
  - Air traffic control
  - Airspace coordination
- BATTLEFIELD AIR PICTURE WILL SIGNIFICANTLY IMPROVE BATTLEFIELD ORIENTATION AND CAPABILITY TO CONTROL MANEUVER AND FIRE SUPPORT RESOURCES
- AIRSPACE COORDINATION WOULD BE SIGNIFICANTLY ENHANCED BY AN INTEGRATED AIR PICTURE FOR A2C2 AND DASC
- PROVIDING SUPPORT FOR BATTLEFIELD AIR PICTURE WOULD NOT NECESSARILY REQUIRE MAJOR INVESTMENT

RPW 12-18-89-21

There are two major conclusions from the air operations assessment regarding a battlefield air picture. First, the Army and the Marine Corps need to specify both general and detailed ADP support requirements for integration of a battlefield air picture in ATCCS and MTACCS, specifically in the systems planned for support of maneuver control, fire support, and airspace control. Requirements for a battlefield air picture are not yet explicitly identified in the ROCs for systems in these areas. Further, there are no documents yet prepared that would define the user requirements for the functionality and information exchange that would be associated with a battlefield air picture. Since the need and benefit of a battlefield air picture is significant for both Services, the users of both Services should coordinate requirements specification activities.

The Services should also work together to exploit the opportunities that have been identified for obtaining air track information, integrating that information with the battlefield situation, and disseminating and displaying the battlefield air picture wherever required. Some of these development activities can be expected to take place under the programs of the aviation C2 program managers. Exploiting the full potential of a battlefield air picture will require support from the the Ground C2 program managers in the maneuver control and fire support areas. In the Army, this would include exploiting as soon as possible the technology being developed for FAAD C2I and examining additional options for obtaining a battlefield air picture from other sources and by other means, at least until FAAD C2I is fielded. For the Marine Corps, this would mean exploiting use of the TFCC improvements and the capabilities of the TAOM, and integrating these into FIREFLEX, FIREMAN, and TCO, as well as the DASC, as required.

The Services should also cooperate on initiatives to address the deficiency in providing surveillance information for low-altitude aircraft. Both Services have very different programs to address this problem by fielding ground-based radars.

Second, looking at the long term, the Services will be examining evolutionary improvements in existing systems and, possibly, a new common air defense module, to develop and disseminate a battlefield air picture. Such a module could be a future follow-on to the AN/TSQ-73, the PATRIOT ICC, and the TAOM for use in support of air defense operations. A substantially down-sized version of the Air Force/Marine Corps' MCE/TAOM could be one of the starting points for such a development program. Potentially, some elements of the FAAD C2I program could be candidates for such a common module, and these should be considered when completed. While the initial focus of development for support of a battlefield air picture would be on access to and integration of existing partial air pictures and battlefield situation data, the long-term initiatives are needed to provide a low-cost, easily transportable module that could perform the air track correlation, identification, and integration functions essential to both air defense and to other tactical uses of a battlefield air picture.

Air Operations Assessment

CONCLUSIONS

- SERVICES NEED TO SPECIFY ADP SUPPORT REQUIREMENTS FOR INTEGRATION OF BATTLEFIELD AIR PICTURE IN MANEUVER CONTROL, FIRE SUPPORT, AND AIRSPACE CONTROL

- MCE/TAOM POTENTIAL STARTING POINT FOR AIR DEFENSE C2 COMMON MODULE AND BATTLEFIELD AIR PICTURE DISSEMINATOR (CONSIDER ALSO ELEMENTS OF FAAD C2I)

RPW 12-18-89-23

The interoperability assessment described in this section focuses on the broad aspects of making increased use of civil data communications standards in military systems. The background addresses open systems interconnection (OSI) protocols and the U.S. and NATO efforts to development military enhancements, where required. The findings and conclusions address areas where improvements can be made.

Interoperability Assessment

5. INTEROPERABILITY

- BACKGROUND
- FINDINGS
- CONCLUSIONS

RPW 12-18-89-24

Substantial progress has been made by the International Standards Organization (ISO) and the International Telephone and Telegraph Consultative Committee (CCITT) in the area of data communications standards for open systems interconnection (OSI). Many of the standards have been formally adopted as International Standards and many others are within 1 or 2 years of final approval. There is great commercial interest in using the standards, partly as a result of intense pressure from procuring bodies to eliminate proprietary architectures and standards. Profiles of these standards are being developed to narrow down the options and interoperability parameters so that products built to these profiles will, in fact, interoperate even when developed independently by different manufacturers. The United States has formally adopted an initial profile called the Government Open Systems Interconnection Profile (GOSIP), and by specifying it as a Federal Standard has mandated it for future procurements.

The NATO Tri-Service Group on Communications and Electronics Equipment (TSGCEE) Subgroup (SG) 9 has been monitoring the progress of OSI standards for many years. NATO has now mandated OSI standards for use as the basis for NATO technical interoperability standards. TSGCEE identified in the early 1980s eight military features that appeared not to be fully satisfied by the emerging standards. These are (1) multihomed and mobile-host systems, (2) multi-endpoint connections (multi-addressing, also known as multipeer data transmission), (3) internetworking, (4) network or system management functions, (5) security, (6) robustness and quality of service, (7) precedence and preemption, and (8) real-time and tactical communications. Some of these (e.g., internetworking) are now covered by the standards and are no longer a major concern. Others would require extensions, options, or other provisions when they are adopted as a NATO Standardization Agreement (STANAG). However, the drafting of these STANAGs is proceeding very slowly. Until the STANAGs are complete, TSGCEE has recommended a set of commercial standards and is developing profiles of the standards.[2]

The U.S. effort in protocol development in general and specifically in assessing the need for military features is now focused in the Protocol Standards Steering Group (PSSG). Through a technical panel and a number of working groups, the PSSG is actively working to develop military supplements to the GOSIP so that procurement authorities can specify the supplement when they specify GOSIP. The initial deadline for the supplement for GOSIP 1.0 is August 1990, when GOSIP is mandatory for military procurements.

OSD has directed that each Service and Agency develop a transition plan to show how GOSIP will be migrated into the communications and information system architectures for the near- and far-term. The deadline for these plans was August 1989, but many have not been submitted in final form. Further, some of them do not anticipate use of GOSIP for tactical systems.

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2 NATO Technical Interoperability Standards Transition Strategy, AC/302-D/347(Revised), CNAD/TSGCEE, 29 September 1989.

Interoperability Assessment

BACKGROUND

- CIVIL OPEN SYSTEMS STANDARDS FOR DATA COMMUNICATIONS PROTOCOLS ARE MATURING
  - -- ISO and CCITT have made great progress in the protocols
  - -- Eight military features were identified in NATO in the early 1980s as areas not adequately addressed in OSI standards
  - -- TSGCEE SG9 is (slowly) developing STANAGs to use civil OSI standards for data communications with military "enhancements"
  - -- U.S. effort is now focused in Protocol Standards Steering Group (PSSG)
- TRANSITION TO CIVIL PROTOCOLS IS MANDATED BY GOSIP
- SERVICES AND AGENCIES ARE REQUIRED TO PROVIDE TRANSITION PLANS

RPW 12-18-89-25

Both the Army and the Marine Corps have efforts underway and specified standards for achieving interoperability among the tactical data systems (TDSs) within the Service architectures, ATCCS and MTACCS, respectively. More could be done. One example would be extending and broadening the cooperative efforts between the Army and the Marine Corps that were developed in 1989. This could lead to multi-Service CASS and possibly the fielding of the same systems for both fire support and maneuver control. Further, as CASS nears its goal, there is greater potential to achieve the close integration of fire support and maneuver that is required for effective employment of combined arms. As suggested earlier in the briefing, one of the elements of CASS could be a module providing support for the battlefield air picture and other modules that enable the Services to exploit access to tactical data links where available.

Use of OSI protocols in tactical systems would permit much of the software associated with modems, interface units, and interface processing to be NDI, commercial off-the-shelf, or even available in firmware supporting open architectures. The great potential for long-term acquisition and maintenance cost benefits makes it critical for the Services to explore all possible options for using OSI or, where necessary, obtaining some extensions to the OSI.

The Services and Agencies need to work with the PSSG to develop both long-term as well as short-term plans for influencing the direction and services provided by the emerging international standards. In September, the U.S. (through its representative to TSGCEE Subgroup 9) recommended that multipeer data transmission become a major U.S. initiative. However, the termination of the ISO effort in its architecture working group (SC21/WG1) could mean that another focus should be adopted. In any case, DoD needs to concentrate its efforts and provide resources to move this work forward. At its December 1989 meeting, the PSSG working group on lower-layer OSI protocols agreed to include development of a long-term plan as a work item. Protocol work is likely to take many years even if aggressively pursued.

The need for efficient data exchange between tactical data systems could lead to the adoption of operational interoperability standards that use a high degree of coding and representations for data objects (including graphical symbols). In addition, where agreements about what has to be sent can be made in advance, procedural means that are more efficient than message text formats may be required. An example would be the use of the message syntax permitted in TADIL J for variable formatted messages and adopted by the Army and the Marine Corps for use with the JINTACCS K-Series fire support messages. These are bit-oriented messages very similar to those in the MTS standard.

Interoperability Assessment

FINDINGS

- CONTINUING CURRENT COOPERATIVE MULTI-SERVICE EFFORTS COULD IMPROVE POTENTIAL FOR AND REDUCE COST OF JOINT INTEROPERABILTY
- TACTICAL USE OF CIVIL OPEN SYSTEMS PROTOCOLS COULD LEAD TO MAJOR COST SAVINGS FOR TDSs
- WORK STILL NEEDS TO BE DONE TO INFLUENCE THE CIVIL TECHNICAL STANDARDS FOR TACTICAL APPLICATIONS
- NEED FOR EFFICIENT DATA EXCHANGE COULD LEAD TO EXTENSIVE CODING AND MORE EFFICIENT SYNTAX (e.g., BIT-ORIENTED MESSAGES)

RPW 12-18-89-26

It is not yet clear if civil standards for open systems interconnection will be adequate for tactical military applications. To address this problem, DoD needs to develop and implement a long-term plan for focusing U.S. activities and influencing standards bodies. In addition, the Services and DoD agencies need to increase their support of activities to analyze requirements, develop prototype solutions, test alternative approaches, demonstrate proposed solutions, and support the U.S. representatives in international standards bodies in advocating the necessary changes to civil standards. Finally, OSD needs to develop mechanisms to ensure better coordination of U.S. efforts in civil and military standards bodies. Coordination should address data management as well as data transmission standards.

In order to support the information exchange requirements of tactical data systems, the Services need to explore increasingly efficient procedures and system design options. These could include extensive coding and data representation; use of file exchange, directory, and other civil standards; bit-oriented syntax for messages; and special database designs to minimize processing.

Interoperability Assessment

CONCLUSIONS

- IT IS NOT YET CLEAR IF CIVIL STANDARDS WILL BE ADEQUATE FOR TACTICAL MILITARY APPLICATIONS; DOD NEEDS
  - -- Long-term plan
  - -- Increased support
  - -- Better coordination of U.S. efforts
- SERVICES NEED TO EXPLORE INCREASINGLY EFFICIENT DATA EXCHANGE AND SYSTEM DESIGN OPTIONS

RPW 12-18-89-27

This section summarizes the major conclusions of the study and identifies some actions that could be taken by the Services and DoD as a result of the study conclusions.

SUMMARY

- MAJOR CONCLUSIONS
- POTENTIAL COURSES OF ACTION FOR ARMY AND MARINE CORPS
- POTENTIAL COURSES OF ACTION FOR OSD

RPW 12-16-89-28

The assessments conducted in this study have shown that the Army and the Marine Corps have very similar requirements in three areas: maneuver control, fire support, and use of a battlefield air picture in air operations for airspace coordination and control. In each of these areas there is potential for the Services to cooperatively develop and field common ADP support.

Specifically, the Army and the Marine Corps could field common objective systems for maneuver control and for fire support. A multi-Service program has already begun for fire support, and the Services are now discussing the possibility of a multi-Service program in maneuver control. Further, the Services have a common need and can be expected to develop similar types of support for a battlefield air picture. A multi-Service program for support of the battlefield air picture could be developed (in support of functions other than air defense).

Unless otherwise directed, the Army and the Marine Corps may implement incompatible standards in their tactical data systems for data communications and data management. An agreement has been reached to provide an interim solution to the incompatibility of the Marine Corps switched protocols and the international standard packet-switched protocols planned for MSE's packet-switched overlay. The two Services, however, have not yet agreed on the protocols to be used to support the JINTACCS K-Series fire support messages in AFATDS. Further, the Services have different programs for standardizing data elements and other aspects of data management for tactical (and other) systems.

Summary

MAJOR CONCLUSIONS

- ARMY AND MARINE CORPS HAVE VERY SIMILAR ADP C2 SUPPORT REQUIREMENTS IN MANEUVER CONTROL, FIRE SUPPORT, AND USE OF BATTLEFIELD AIR PICTURE

- THERE IS A POTENTIAL FOR BOTH SERVICES TO FIELD:
  - -- Common objective system for maneuver control
  - -- Common objective system for fire support
  - -- Common ADP support for a battlefield air picture

- UNLESS OTHERWISE DIRECTED, SERVICES MAY IMPLEMENT INCOMPATIBLE STANDARDS FOR DATA COMMUNICATIONS AND DATA MANAGEMENT

RPW 12-18-89-29

This chart identifies several courses of action that could be taken by the Army and the Marine Corps to address the findings and conclusions of this study.

Both Services need to review their current specifications for the type and degree of automation needed to ensure that the appropriate level of detail for ADP support requirements is provided to system developers. The level of detail of the user specification of automation requirements varies greatly between the two Services and among the tactical data systems of each Service. Both Services should consider developing a system to prioritize requirements for each block improvement. The Army's Red Book on the functional specification of fire support is an example of users providing a statement of what functions are performed, which are to be automated, and what degree of automation is needed.

Both Services should continue to reassess the voice and data communications required to support tactical command and control as increasing ADP support is provided in the 1990s and beyond. New assessments should provide a means to estimate the communications required to support information exchange requirements for a range of scenarios and operating conditions, including operation in degraded modes. The Services should consider using the same or compatible assessment models where possible. Potentially, the assessments will lead to additional requirements on tactical data systems that will ensure these systems can operate effectively when fielded communications systems degrade or if enhanced communications systems are not fielded as planned.

As the Army and Marine Corps work together in multi-Service programs for maneuver control and fire support, they should consider the development of concepts that will also apply to the ADP support for Joint Task Force C2. Many of the elements of force-level control, maneuver control, and fire support for Joint and combined arms operations and MAGTF C2 appear to be very similar to those required for Joint Task Force C2.

The Marine Corps needs to complete work on its revised concept for MTACCS and requirements specification for MAGTF C2 and the four functional areas. Specifically, detailed information exchange requirements are needed to define interfaces among tactical data systems within the functional areas (e.g., between FIREMAN and FIREFLEX) and among the functional areas (e.g., between ATACC and FIREFLEX). Further, the ROC for FIREMAN needs to be approved, and the 1978 TCO ROC needs to be reviewed in relation to the revised MTACCS concept. Finally, detailed ADP functions need to be defined by the users to show the type and degree of automation that is to be developed for the tactical data systems in MTACCS. Examples of such specifications in the Army are the MCS Design Consideration Memoranda (for maneuver and force-level control) and the Red Book (for fire support).

Summary

POTENTIAL COURSES OF ACTION FOR ARMY AND MARINE CORPS

- DETERMINE IF THE CORRECT TYPE AND DEGREE OF AUTOMATION IS SPECIFIED FOR BATTLEFIELD C2 TASKS
- ASSESS ADEQUACY OF EXISTING AND PLANNED COMMUNICATIONS TO SUPPORT TACTICAL DATA SYSTEMS
- DEVELOP CONCEPTS TO IMPROVE ADP SUPPORT FOR JOINT TASK FORCE C2
- MARINE CORPS TO COMPLETE WORK ON REVISED MTACCS CONCEPT AND REQUIREMENTS FOR:
  - -- Exchange of information among the functional areas and between C2 systems
  - -- FIREMAN and revised TCO systems
  - -- Detailed ADP functions for FIREFLEX, FIREMAN, and TCO

RPW 12-18-89-30

This chart identifies three potential courses of action for OSD based on the findings and conclusions of this study.

First, OSD could continue to support Service initiatives that lead to multi-Service programs to develop common systems for fire support, maneuver control, and a battlefield air picture. A multi-Service fire support program could lead to a common objective system for the Army's AFATDS and the Marine Corps' FIREFLEX in FY94. In addition, a multi-Service maneuver control program could lead to a common objective system for the Army's MCS and the Marine Corps' FIREMAN (and possibly TCO) in FY93. Finally, a multi-Service program could be developed to exploit the opportunities to acquire and distribute a battlefield air picture.

Second, OSD could request the Army and the Marine Corps to provide briefings on the Service efforts to develop and expand multi-Service initiatives, to adopt common standards between the two Services, and to work together towards use of hardware and software common to both Services.

Third, OSD could request DCA and JTC3A to take two actions that would improve progress toward interoperability. One would be to ensure that the Army and the Marine Corps quickly complete their discussions on the initial Joint information exchange standards to be used in Version 1 of AFATDS. Unless agreement is reached, the Services could implement incompatible data communications protocols. A second action would be for DCA and JTC3A to develop a detailed, long-range plan to focus U.S. initiatives for enhancing civil standards for open systems interconnection for tactical use. Such a plan would extend the current work on developing supplements to GOSIP and the Services' plans to transition to GOSIP.

Summary

POTENTIAL COURSES OF ACTION FOR OSD

- **OUSD(A)/TWP/LW AND ASD(C3I)-T&TC3 COULD:**

  (1) Support Service initiatives to develop

  - **Multi-Service AFATDS**
  - **Multi-Service MCS**
  - **Capabilities to exploit battlefield air picture**

  (2) Request Service briefings on efforts to use common standards, hardware, and software for ADP C2 support

  (3) Request that DCA/JTC3A:

  - **Ensure Army and Marine Corps complete work quickly on Joint information exchange standard for AFATDS**
  - **Develop a detailed plan to focus U.S. initiatives to enhance civil standards for OSI for tactical use**

RPW 12-18-89-31

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Appendix A

GLOSSARY

Appendix A

GLOSSARY

A2C2	Army Airspace Command and Control
ABIC	Army Battlefield Interface Concept
ABMOC	Air Battle Management Operations Center (U.S. Army)
AC2MP	Army Command and Control Master Plan
ACC	Air Component Commander
ACE	Aviation Combat Element (USMC)
ADA	Air Defense Artillery
ADatP	Allied Data Publication (NATO)
ADCCS	Air Defense Command and Control Systems
ADP	Automated Data Processing
AFATDS	Advanced Field Artillery Tactical Data System
ALADNS	Automatic Location and Data Netting Systems (PLRS modification)
APIU	Adaptive Programmable Interface Unit
ARTEP	Army Training and Evaluation Plan
ASARC	Army Systems Acquisition Review Council
ASAS	All-Source Analysis System
ASD	Assistant Secretary of Defense
ATACC	Advanced Tactical Air Command Center
ATACMS	Army Tactical Missile System
ATC	Air Traffic Control
ATCCIS	Army Tactical Command and Control Information System (NATO)
ATCCS	Army Tactical Command and Control System (U.S. Army)
ATHS	Airborne Target Handoff System
AWACS	Airborne Warning and Control System (USAF)
AWIS	Army WWMCCS Information System
BCS	Battery Computer System
BFA	Battlefield Functional Area

BITE	Built-In Test Equipment
BOM	Bit-Oriented Message
C2	Command and Control
C2IE	Command and Control Information Exchange (element)
C2MP	Command and Control Master Plan
C3	Command, Control, and Communications
C3CM	C3 Countermeasures
C3I	Command, Control, Communications, and Intelligence
C4	Command, Control, Communications, and Computers
CAC	Combined Arms Center (U.S. Army)
CACDA	Combined Arms Center Development Activity (U.S. Army)
CAEMS	Computer-Aided Embarkation System
CAS	Close Air Support
CASS	Common Applications Support Software (ATCCS)
CCIR	Commander's Critical Information Requirements
CCIS	Command and Control Information System
CCITT	International Telephone and Telegraph Consultative Committee
CCS	Command and Control Systems
CECOM	U.S. Army Communications-Electronics Command (Fort Monmouth)
CEI	Critical Elements of Information
CEOI	Communications-Electronics Operating Instructions
CHS	Common Hardware and Software
CMD	Color Monitor Device (ATCCS CHS)
CNAD	Council of Naval Armaments Directors (NATO)
COC	Combat Operations Center
COEA	Cost and Operational Effectiveness Assessment
COMSEC	Communications Security
CONOPS	Continuity of Operations
CP	Command Post
CRC	Control and Reporting Center (USAF)
CSS	Combat Service Support
CSSCS	Combat Service Support Control System (ATCCS)
CSSE	Combat Service Support Element (USMC)
CSSIN	CSS Information Network

DAB	Defense Acquisitions Board
DASC	Direct Air Support Center (USMC)
DCA	Defense Communications Agency
DCT	Digital Communications Terminal
DDN	Defense Data Network
DEUCE	Down-Sized End-User Computer Equipment
DIR	Director
EDM	Engineering Development Model (MIFASS)
EPLRS	Enhanced Position Location Reporting System
ETACCS	European Theater Air Command and Control System
EUCE	End-User Computer Equipment
EW	Electronic Warfare
FAAD	Forward Area Air Defense (low-altitude)
FAC	Forward Air Controller
FAMMIS	Finance and Manpower Management Information System
FAR	Forward Area Radar
FATDS	Field Artillery Tactical Data Systems
FCC	Flight Coordination Center (U.S. Army)
FDC	Fire Direction Center
FDDS	Flag Data Display System (USN)
FDL	FAAD Data Link
FED	Forward Entry Device
FIA	Functional Interoperability Architecture
FIREFLEX	Flexible Fire Support System (USMC)
FIREMAN	Fire and Maneuver System (USMC)
FIST DMD	Fire Support Team Digital Message Device (U.S. Army)
FLCC	Force-Level Control Capability
FLCS	Force-Level Control System
FLOT	Forward Line of Troops
FM	FIREMAN
FMF	Fleet Marine Force
FMFM	Fleet Marine Force Manual
FO	Forward Observer
FOC	Flight Operations Center (U.S. Army)

FS	Fire Support
FSCC	Fire Support Coordination Center (USMC)
FSE	Fire Support Element (U.S. Army)
FSSG	Fire Support Subgroup (JTC3A)
FUE	First Unit Equipped
FY	Fiscal Year
GCE	Ground Combat Element (USMC)
GKS	Graphics Kernel System
GOSIP	Government Open Systems Interconnection Profile
GPS	Global Positioning System
HDU	Hard Disk Unit (ATCCS CHS)
HF	High Frequency
HIMAD	High- and Medium-Altitude Air Defense
HIP	Howitzer Improvement Program
HMMWV	High Mobility Multi-Wheeled Vehicle
HQDA	Headquarters, Department of the Army
HQMC	Headquarters, USMC
HTU	Handheld Terminal Unit
IAS	Intelligence Analysis System
ICC	Information Coordination Central (PATRIOT)
IDASC	Improved Direct Air Support Center
IEEE	Institute of Electrical and Electronics Engineers
IER	Information Exchange Requirement
IEW	Intelligence and Electronic Warfare
IFASC	Improved Force Automated Services Center
IHFR	Improved High Frequency Radio
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IPS	Interoperability Planning System (JTC3A)
ISO	International Standards Organization
ITAWDS	Integrated Tactical Amphibious Warfare Data System
ITC	Inter-Task Communications

JCS	Joint Chiefs of Staff
JFLCS	Joint Force-Level Control System
JINTACCS	Joint Interoperability Tactical Command and Control System
JMSWG	Joint Multi-TADIL Standards Working Group (JTC3A)
JSIPS	Joint Service Imagery Processing System
JTC3A	Joint Tactical C3 Agency
JTF	Joint Task Force
JTIDS	Joint Tactical Information Distribution System
LAAD	Low-Altitude Air Defense
LAN	Local Area Network
LCAC	Landing Craft, Air-Cushioned
LCC	Land Component Commander
LHA	Amphibious Assault Ship
LHD	Amphibious Assault Ship
LLEWDS	Low-Level Early Warning Defense System
LSPP	Large-Scale Printer/Plotter
LTACFIRE	Lightweight TACFIRE (Briefcase Terminal)
LW	Land Warfare
M3S	Marine Corps Standard Supply System
MACCS	Marine Air Command and Control System
MAFATDS	Marine Version of AFATDS
MAGIS	Marine Air-Ground Intelligence System
MAGTF	Marine Air-Ground Task Force
MARDIV	Marine Division
MASC	MAGTF Automated Services Center
MATCALS	Marine Air Traffic Control and Landing System
MCC2MP	Marine Corps Command and Control Master Plan
MCCDC	Marine Corps Combat Development Command
MCE	Modular Control Equipment (USAF)
MCRDAC	Marine Corps Research, Development and Acquisition Command
MCS	Maneuver Control System
MCTCA	Marine Corps Tactical Communications Architecture
MCTSSA	Marine Corps Tactical Systems Support Activity
MDS	Meteorological Data System

MEB	Marine Expeditionary Battalion
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MIFASS	Marine Integrated Fire and Air Support System
MILOGS	Marine Integrated Logistics System
MILSPEC	Military Specification
MIPS	Marine Integrated Personnel System
MLRS	Multiple Launch Rocket System
MOA	Memorandum of Agreement
MS	Master Station (PLRS)
MSE	Mobile Subscriber Equipment (U.S. Army)
MTACCS	Marine Tactical Command and Control System
MTF	Message Text Format (JINTACCS)
MTP	Mission Training Plan (U.S. Army)
MTS	Marine Tactical System (USMC)
NBC	Nuclear, Biological, and Chemical
NDI	Non-developmental Item
NGF	Naval Gunfire
NIMP	NATO Interoperability Management Plan
NIPD	NATO Interoperability Planning Document
NTDS	Naval Tactical Data System
O&O	Organizational and Operational (Plan)
OASD	Office of the Assistant Secretary of Defense
OH	Operational Handbook (USMC)
OPM	Office of the Program Manager
OPTADS	Operational Tactical Data Systems
OSD	Office of the Secretary of Defense
OSI	Open Systems Interconnection
OTEA	Operational Test and Evaluation Agency
P3I	Preplanned Product Improvements
PA&E	Program Analysis and Evaluation (OSD)
PC	Personal Computer
PCU	Portable Computer Unit (ATCCS CHS)

PEO	Program Executive Officer
PJHI	PLRS-JTIDS Hybrid Interface
PLI	Position Location Information
PLRS	Position Locating Reporting System
PNL	Battelle Pacific Northwest Laboratories
POSIX	Portable Operating System Interface for Computer Environments
PSSG	Protocol Standards Steering Group
PSTP	Protocol Standards Technical Panel
R&D	Research and Development
RFP	Request for Proposals
ROC	Required Operational Capability (statement)
RPV	Remotely Piloted Vehicle
SACC	Supporting Arms Command Center
SAM	Surface-to-Air Missile
SBB	Switched Backbone (USMC communications)
SC	Subcommittee
SCR	Single-Channel Radio
SDU	Standalone Display Unit (ATCCS CHS)
SEMA	Special Electronic Mission Aircraft
SINCGARS	Single-Channel Ground-Air Radio System
SM	System Management
SMI	Soldier-Machine Interface
SMRAALS	Shipboard Remote Area Approach and Landing System
SOR	Statement of Requirements
SQL	International Standard Query Language
SRI	Standing Request for Information
STAMIS	Standard Tactical Army Management Information System
STANAG	NATO Standardization Agreement
T&TC3	Theater and Tactical C3
TACFIRE	Tactical Fire Direction System (U.S. Army)
TACS	Tactical Air Control System (USAF)
TADIL	Tactical Data Link
TAIS	Tactical Air Integration System

TAOC	Tactical Air Operations Center
TAOM	Tactical Air Operations Module (USMC)
TBD	To Be Determined
TCAC	Technical Control and Analysis Center
TCO	Tactical Combat Operations (system) (USMC)
TCP	Tactical Computer Processor
TCT	Tactical Computer Terminal
TCU	Transportable Computer Unit (ATCCS CHS)
TDS	Tactical Data System
TERPES	Tactical Electronic Reconnaissance Processing and Evaluation System
TFCC	Tactical Flag Command Center
TFDS	Tactical Flag Data System
TIC	Technical Interface Concept
TIDP	Technical Interface Design Plan
TRADOC	U.S. Army Training and Doctrine Command
TRI-TAC	Joint Tactical Communications Program
TSGCEE	NATO Tri-Service Group on Comm-Electronics Equipment
TWP	Tactical Warfare Programs (OSD)
UIR	User Information Requirement
ULCS	Unit-Level Circuit Switch
ULTDS	Unit-Level Tactical Data Switch (USMC)
USAREUR	U.S. Army in Europe
UTACCS	USAREUR Tactical Command and Control System
VMF	Variable Message Format (JINTACCS K-Series)
VTOL	Vertical Take-Off and Landing
WG	Working Group
WIS	WWMCCS Information System
WWMCCS	World-Wide Military Command and Control System

Appendix B

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